Refining element

This invention relates to refiners of disc-type, which are plane or conical, with opposed refining discs rotating relative to one another. The refining discs are provided with refining elements, which between themselves form a refining gap for the working of fibrous material. The fibrous material preferably is lignocellulosic, and the refiner is used for the manufacture of, for example, reject pulp, recycled fiber pulp and mechanical pulps such as board pulp, thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP) as well as for the low-concentration refining of chemical pulps.

The invention, more precisely, relates to a refining element to be used in a refiner of the above kind.

A refining element is formed with a pattern of bars and intermediate grooves. The bars and grooves are formed in different ways, depending on which fibrous material is worked and which degree of working and, thus, in the case of lignocellulosic material, which pulp quality is desired. The bars have an upper surface and side surfaces in such a way, that longitudinal edges are formed between the upper surface and respective side surface. The bars can be, for example, continuous or discontinuous and arranged in various patterns. The working of the fibrous material is carried out substantially by the bars of the refining elements. The refining gap is formed so, that the fibrous material, seen in radial direction, shall pass from the inside outward. Farthest inward in the refining gap, the refining elements normally are formed to bring about a first disintegration of the material and to advance the material outward in the refining gap. A certain defibering, i.e. separation of the fibers of the lignocellulosic material, also takes place in the inner portion of the refining gap, where the distance between the refining surfaces is the greatest. Thereafter the distance decreases outward in order that the desired working or refining of the fibrous material shall be achieved.

At the refining of fibrous material of high concentration and, above all, at high energy inputs, it was found necessary to form the outer portion of the refining element with a tight pattern of bars and grooves in order thereby to improve the access to the fibrous material and to bring about an effective working. The bar width can here be 1-2 mm

and the groove width 1,5 – 2 mm. This working generates at the same time a great amount of steam in the refining gap. This gives rise to a high steam pressure in the refining gap. This high steam pressure has a negative effect on the capacity and operational stability of the refiner. This also implies a restriction of the possible energy input. The steam developed will, as a result of the tight pattern, be forced up out of the grooves and disturb the material flow through the refining gap.

One way of solving this problem would be to supply dilution water to the refining gap in order thereby to condense the steam. This, however, would reduce the material concentration to a low level and thereby deteriorate the pulp quality.

At the working or refining of fibrous material with low concentration no steam development takes place, and the material is transported partly by the liquid flow out of the refining gap. Here a tight pattern of bars and grooves implies, that the flow through the refining gap can be much too low.

The present invention offers a solution of the above problems. According to the invention, the bars and grooves have a greater width in order to allow steam transport and, respectively, liquid flow out of the refining gap, at the same time as the upper surfaces of the bars are provided with a plurality of smaller grooves obliquely or across the bars so that they form an angle of 10– 90°, suitably 10-70°, with the longitudinal direction of the bars. These smaller grooves suitably are linear, but possibly can be slightly curved. The smaller grooves suitably are open to both side surfaces of the bars. By this design of the bars the fibrous material will be worked effectively and at the same time the steam or liquid flow is collected in the grooves between the bars and led out of the refining gap without disturbing the flow of the fibrous material.

The smaller grooves, for example, can be placed along the entire length of the bars or be broken off by small portions without grooves, counted in longitudinal direction of the bars.

The wide bars, according to the invention, extend arc- or bow-shaped over the refining element and the small grooves are angular in relation to the longitudinal direction of the bars.

The characterizing features of the invention are defined in the attached claims.

The invention is described in greater detail in the following with reference to the accompanying Figures showing some embodiments of the invention.

Fig. 1 shows the front side of a refining element according to the invention;

Figs. 2 - 4 show the upper surface of the bars with different designs;

Fig. 5 is a section according to V-V in Fig. 2.

In Fig. 1 is shown a refining element 10, which is intended to refine fibrous material with high concentration. The refining element 10 is provided with a pattern of bars 11 and intermediate grooves 12, where the bars have upper surfaces 13 and side surfaces 14 with edges 15. The pattern is divided into two zones, one inner zone 16 and one outer zone 17, where the bars and grooves in the inner zone are sparser than in the outer zone. The bars in the inner zone are intended to bring about a first disintegration of the material and to advance the material outward to the outer zone. The bars in the outer zone are placed more tightly, which implies more bar edges for effecting the substantial working and refining of the material. The pattern can also comprise more zones where the pattern usually is made tighter from zone to zone, radially outward.

Due to the bars being provided with oblique smaller grooves 18 in the upper surfaces, the bars as well as the intermediate grooves can be made wider without the working upper surface of the bars losing their effectiveness. The wider grooves imply simultaneously that the steam and, respectively, liquid flow in the grooves is facilitated and the disturbance of the working of the fibrous material is minimized. The bar width can be 3-30 mm and the groove width 2-15 mm with a depth of 5-15 mm. The deepest grooves at low-concentration refining.

Fig. 2 shows an embodiment of the bars 11 on a refining element according to the invention. Along the bars 11 a plurality of smaller grooves 18 are placed, which are arranged slightly angular in relation to the longitudinal direction of the bars and should be open to both side surfaces 14. The depth of the smaller grooves should be one or

some millimetres, preferably 1-5 mm. Their width should be 0.5-2 mm. The distance between adjacent smaller grooves should be 1-10 mm, preferably 2-5 mm.

In Fig. 3 the bars are arc-shaped and the smaller grooves 18 on the upper surface of the bars are always oblique in relation to the longitudinal direction of the bars. The smaller grooves should have a substantially radial direction. As to the design of the smaller grooves (18), the same dimensions apply as in Fig 2.

According to Fig. 4, the smaller grooves 18 are angular in different directions, preferably in such a way that they cross each other on the upper surface of the bars 11. Alternatively, they can be offset in the longitudinal direction of the bars, so that they do not cross each other. These embodiments allow that the rotation direction of the refining element can be changed. As to the design of the smaller grooves 18, the same dimensions apply as in Fig. 2.

Bars with a design according to the invention can be placed in any zone on the refining element, but preferably in an outer zone where the working and refining are most intensive, and the distance between opposed refining elements is the shortest, i.e. the refining gap is the smallest and the steam development the greatest.

At the working of fibrous material with refining elements according to the invention, the upper surfaces of the bars 11 and the edges of the smaller grooves 18 will work on the material. The steam development arising at high material concentration and the liquid flow passing through the refining gap at low material concentration are led away from the upper surfaces of the bars and can pass out through the grooves between the bars, so that the working of the fibrous material is not disturbed. Thereby a high capacity can be achieved at maintained pulp quality. By designing the refining elements with arc-shaped wide bars 11 with substantially radial smaller grooves 18 on the upper surface, an increased capacity can be obtained. At the same time a high pulp quality is achieved, in that the smaller grooves bring about an effective fibrillation of the fibrous material.

The invention, of course, is not restricted to the embodiments shown, but can be varied within the scope of the claims with reference to the description and Figures.